The Effects of Self-Selected versus Researcher-Selected Music on Psychological, Physiological and Performance Outcomes During a Running Task

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Abstract

The present study examined the effects of self-selected versus researcher-selected music on psychological, physiological and performance variables during a treadmill running task. Male and female participants (n = 30) performed a 30-minute treadmill run to their own self-selected music, researcher-selected motivational music and a no-music condition. Participants were assessed on intrinsic motivation, enjoyment, RPE, distance and heart rate. A series of repeated measures ANOVAs were used to analyse the data. Results indicated that following listening to their self-selected music, participants reported being more intrinsically motivated, more enjoyment, greater rating of perceived exertion and greater distance run. This study suggest that self-selected music may be an avenue to helping individuals overcome barriers to physical activity such as intrinsic motivation and enjoyment to help promote greater physical activity participation and adherence.

Key words: Music, physical activity, psychological, physiological, performance

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CHAPTER 1: LITERATURE REVIEW

1.1 Physical Activity

Physical activity is any movement created by the generation of force using skeletal muscle, which leads to the use of energy above resting levels (Caspersen, Powell, & Christenson, 1985). Thus, physical activity encompasses a variety of activities including exercise, sport and activities of daily living. Physical activity has been shown to have numerous health and well-being benefits (Appleton, 2012).

1.1.1 Importance of Physical Activity. Regular physical activity is effective in the reduction of risk of many chronic illnesses, including but not limited to cardiovascular disease, diabetes, cancer, hypertension, obesity, depression and osteoporosis (Warburton, Nicol, & Bredin, 2006). Further, men and women who reported increased levels of physical activity were found to have reductions in relative risk (~20% - 35%) of all-cause mortality (Warburton et al., 2006). The effects of physical activity appear to be graded, where even small improvements in physical fitness are associated with significant reductions in health risks (Warburton et al., 2006). In a study conducted by Erikssen and colleagues (1998), it was shown that participants with the highest levels of physical fitness at baseline who maintained or improved their levels of physical fitness over time had the lowest risk of premature death.

Within sedentary samples, it has been noted that moderate increases in physical activity lead to substantial improvements in health (Myers et al., 2002). In a male sample, participants who increased their physical activity over a 5-year period showed a 44% decrease in all-cause mortality risk compared to those who remained sedentary (Blair, Kohl, & Barlow, 1995). In females, a negative relationship has been documented between physical activity and risk of cardiovascular death. Females with the highest levels of physical fitness had the lowest relative risk when compared to women with the lowest level of physical activity. These beneficial attributes of physical activity were documented with as little as 1-hour of walking per week (Oguma & Shinoda-Tagawa, 2004). Furthermore, a dose-response relationship seems to exist, where people with the highest levels of physical fitness having the lowest risks (Warburton et al., 2006).

In addition to the physical benefits, there has also been research to indicate the benefits to psychological well-being from physical activity (Penedo & Dahn, 2005). Research has indicated that physical activity may decrease symptoms of depression and anxiety, while enhancing mood (Ross & Hayes, 1988). In a study conducted by Babyak and colleagues (2000), there was a significant improvement in coping with depression symptoms in participants who were undergoing an aerobic-exercise intervention when compared to those who were being given psychotropic treatment (Babyak, Blumenthal, & Herman, 2000). Consistent with these findings is research done by Legrand (2014) in which women showed significant decreases in self-reported depression symptoms after an exercise intervention compared to the wait-listed (control) condition. Moreover, research indicates that physical activity may aid in the prevention of the onset of depression. It was noted that depression rates were lower amongst college males who were physically active and played sport compared to those who were not (Paffenbarger, Lee, & Leung, 1994). It has also been shown that those who participate in physical activity report more positive self-concept and self-perceptions, including higher physical self worth and higher global self-esteem (Biddle, Fox, & Boutcher, 2000; Chen, 2014). In a sample of low socioeconomic status women it was noted that there was an increase in physical self-esteem in those women who were placed in an exercise intervention compared to a wait-list control condition (Legrand, 2014).

In regards to body image, correlational and experimental research has shown that physical activity is associated with less negative body image (Hausenblas & Fallon, 2006). Also, researchers have suggested that physical activity is positively associated to body appreciation, internal body orientation and functional body satisfaction, all intermediaries to positive body image (Homan & Tylka, 2014). Physical activity has also been linked to improved quality of life. For example, in a sample of 1527 women, baseline self-reported levels of physical activity were positively correlated to greater self-efficacy, which in turn was linked to higher physical, emotional, functional and social well-being, 6 months later (Phillips & McAuley, 2014).

1.1.2 Physical Activity Recommendations. Although it is evident that physical activity leads to numerous health benefits, the optimal dosage and volume of physical activity is still debated. Most health organizations and professionals recognize health benefits with a minimum expenditure of 1000 kilocalories (kcal) per week; (kilocalorie = 1000 calories), with an increase in benefits as physical activity increases (Warburton et al., 2006). For adults 18-64 years and older, it is recommended to attain at least 150 minutes of moderate to vigorous physical cardiovascular activity per week (Canadian Society for Exercise Physiology, [CSEP] 2012). It is also recommended that adults add in at least 2 days per week of muscle and bone strengthening exercises to the major muscle groups by doing resistance exercises (CSEP, 2012).

1.1.3 Rates of Physical Activity. Although the rates of physical activity have risen since 1995 by 11.2% (Statistics Canada, 2012), the Canadian Community Health Survey indicated that only 48% of persons age 20 and over were receiving the recommended amount of daily moderate to vigorous physical activity needed to acquire health benefits (Canadian Fitness and Lifestyle Research Institute, 2009). Further, men were more active than women and with increasing age came a decrease in physical activity participation rates (CFLRI, 2009).

1.1.4 Barriers to Physical Activity. Several factors may contribute to the low levels of physical activity in the Canadian population. One of the most commonly cited barriers to physical activity is a perceived lack of time (Chinn, White, Harland, Drinkwater, & Raybould 1999). Forty-seven percent of males and 51% of females indicated that lack of time was one of the major barriers to engaging in physical activity (Chinn et al., 1999). It has been noted that personal barriers such as lack of time are generally inversely reported with time spent engaging in physical activity (Salmon, Crawford, Owen, Bauman, & Sallis, 2003).

Another barrier that may contribute to the low rates of physical activity is a lack of motivation to initiate or continue physical activity. In a study conducted by Chinn et al. (1999), 46% of males and 48% of females reported lack of motivation as the principal barrier for not engaging in sufficient physical activity. Lack of enjoyment has also been linked to insufficient physical activity participation. Salmon et al. (2003) found that enjoyment was a significant predictor of participation in four physical activity categories (walking, moderate, vigorous and total physical activity). Wankel (1985) also found that enjoyment was a predictor of exercise involvement through interviews with continuing participants and dropouts of a fitness program. It was noted that continuing participants reported greater liking of the program when compared to those who dropped out (Wankel, 1985). Thus, finding methods that may increase motivation and/or enjoyment may be one way to increase physical activity behaviour.

Winingar and Pargman (2003) investigated the relationship between three variables (satisfaction with music, satisfaction with instructor and role-identity) and enjoyment of exercise. It was shown that all three variables were positively correlated with exercise enjoyment, with satisfaction with music accounting for the greatest variance of the three (Winingar & Pargman, 2003). Given the link between enjoyment and exercise behaviour, and the link between music during exercise and enjoyment, it is possible that music may be one potential way to increase physical activity participation rates.

1.2 Music

Music is the art and science of organizing vocals, instruments, or both, of varying pitch and volume into rhythmical, harmonic and melodic patterns to produce a composition having structure and unity. Musical pieces are primarily organized using the five primary elements of melody, harmony, rhythm, tempo and dynamics (Karageorghis & Terry, 2009). Melody refers to the tune of the music, the part that can be whistled or hummed. Harmony encapsulates the mood of the piece, giving the feeling that might be experienced when listening to a particular selection of music (e.g., sad, happy, etc.). Rhythm accentuates the distribution of notes over a given timeframe, while tempo is the speed at which the music is played at, often measured in beats per minute (bpm). Lastly, the dynamics of a given musical piece are defined by the energy that is transmitted through the music via a musician's voice or instrumentation (Karageorghis & Terry, 2009).

1.2.1 Types of Music. Music can be classified in different ways. It can be organized into different categories, such as genre (the particular style of musical composition, such as punk, rap, or country), date of release (e.g., 80's sounds, 90's hits), or tempo (the speed at which music is played or sung, such as fast, slow). It can also be classified based on whether it is synchronous or asynchronous. Asynchronous music is background music that is used to make an environment more pleasant. For example, the music played in the background at gyms and exercise facilities is considered asynchronous (Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006). Asynchronous music has no conscious synchronization between a person's movements and the tempo of the music (Karageorghis & Terry, 1997). By contrast, in synchronous music the rhythmic and temporal aspects of music are used in order to consciously sync together with individual's movement patterns (Hayakawa, Miki, Takada, & Takada, 2000).

Music can also be classified by its given effect on mood (e.g., sedative or stimulating). When music is quiet and a basic rhythm is repeated with a sustainable melody, it is termed sedative music. This type of music gives off a hypnotic effect as in the case of a lullaby (Gaston, 1951). Sedative music is generally characterized by a slower tempo (<100bpm) and comprised of an overall slower pace in comparison to stimulative music (Karageorghis, Drew, & Terry, 1996). Most research has studied sedative music in relation to pre-task activities (Gaston, 1951; Hirokawa, 2004), while relatively little research has looked at the effects of sedative music on physical performance; however Karageorghis et al. (1996) noted that sedative music did yield lower handgrip scores when compared to stimulative music or white noise.

In contrast, music that is stimulative tends to be faster in tempo (>130bpm; (Karageorghis et al., 1996) and enhances physical energy (Gaston, 1951). Scientific inquiry into the effects of music on physical activity has predominantly looked at stimulative music; this term has come to be renamed motivational music (Karageorghis, Terry, & Lane, 1999).

1.2.2 Motivational Music. Within the context of physical activity, motivational music is defined as functional music, having the aim to improve mood, reduce ratings of perceived exertion and attain optimum arousal (Karageorghis et al., 1999). Motivational music is characterized by four factors, two of which are internal (pertaining to the music itself), and two that are external (referring to the individual's interpretation of the music). Further, these characteristics of a given musical selection are thought to have a hierarchical order, which helps determine what makes a musical piece more or less motivational (Karageorghis et al., 1999).

The first and most important characteristic is *rhythm response*, which refers to the musical rhythm or the regular repeated pattern of sounds. This is thought to be the most important factor of motivational music as human beings are rhythmic by nature; for example, basic physiological functions and activities such as respiration and walking are cyclical (Hohler, 1989). Second is the *musicality* or pitch-related elements that are heard when listening to music. Third is the *cultural impact,* which is concerned with the pervasiveness of music within society or a subculture. Lastly is the *association* that a piece of music evokes when it is listened to, be it the thoughts, feelings or emotions that are experienced by an individual upon hearing it (Karageorghis et al., 1999).

1.2.3 Conceptual Model. Karageorghis and Priest (2012) developed a conceptual framework to describe the effects of motivational music in physical activity settings (see Figure 1). First, there are the antecedents of personal and situational factors. The effect of music on physical activity may be influenced by personal factors such as age, gender, personality type, commitment to exercise and attentional style. Situational factors include the setting or specifics related to the exercise regimes (e.g., type of exercise). These factors may influence the intermediary motivational qualities of music. The first two qualities (rhythm response, musicality) are the internal factors, as they represent the objectively audible characteristics of the music. The final two qualities (cultural impact and association) represent the external factors. Music selections that heighten these external factors are thought to show significant benefits, especially when looking at cognitive and affective outcomes (Karageorghis & Priest, 2012). These motivational qualities of music may then lead to potential benefits in three different categories: psychological, (which includes psychophysical) physiological, and ergogenic. Ultimately, motivational music provides two potential benefits to physical activity performance: promoting more proficient pre-event routines for athletes and increasing exercise adherence amongst exercisers, according to the model (Karageorghis & Priest, 2012).

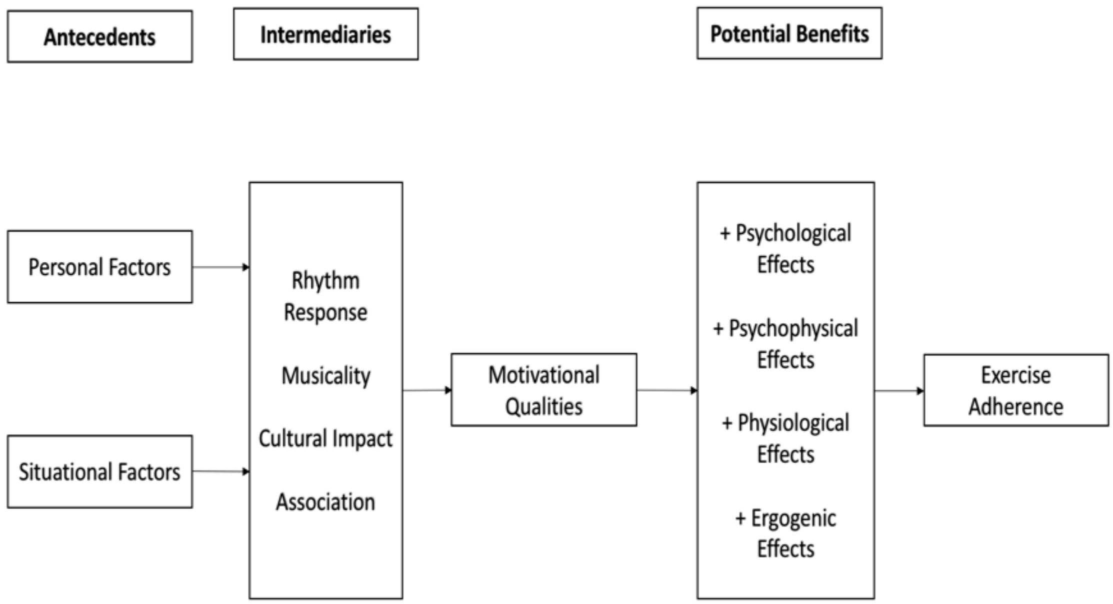

Figure 1: Conceptual framework for prediction of responses to motivational music in exercise. Adapted from Karageorghis & Priest, 2012, Figure 1 & Figure 2.

1.2.4 Measurement of Motivational Music. In order to determine the motivational qualities of music with reference to exercise and sport, the Brunel Music Rating Inventory (BMRI) was developed. The BMRI allowed for the selection of music that athletes and exercisers would consider motivational, as previous research had found equivocal results for the effects of music on physical activity (Karageorghis et al., 1999). Follow-up analysis identified flaws in the original BMRI. These included different factor structures across two different groups of exercisers (instructors versus participants) and low internal consistency for the cultural factor. Further several specific items on the BMRI loaded weakly on their hypothesized factors or yielded measurement error. In addition, content validity was assessed using a sample of aerobics instructors but not by general exercise participants, limiting its generalizability (Karageorghis, Priest et al., 2006). Also, it was not usable by those who were not experts in the field of music or experts on how music was to be applied to physical activity, limiting its utility.

The BMRI–2 was developed to address these limitations and to enable the selection and identification of motivational music for exercise settings and exercise-related research by non-experts, who may not be able to differentiate between the various elements of music. The BMRI-2 was validated across a range of physical activity settings, having a mixture of both exercise and sport participants, as well as across gender, thereby increasing the generalizability of the instrument to various forms of physical activity (Karageorghis, Priest et al., 2006). The authors provided evidence of validity and reliability for the instrument that would allow instructors and participants to select motivational music, and allow researchers to standardize music across experimental conditions.

1.2.5 Music and Physical Activity. Karageorghis and Terry (1997) identified three types of outcomes that music can impact during physical activity, including sport and exercise. First, there are the *psychological* effects of music, which include how music may affect mood, emotion, affect, and cognition (Karageorghis & Priest, 2012). Within the psychological effects, there are also the *psychophysical* effects of music, which refer to the psychological perceptions of physical effort and fatigue (i.e., perceived exertion); this aspect is concerned with the subjective estimation of physical effort (Karageorghis & Priest, 2012). The second category is the *physiological* effects, referring to music's effects on physiological variables including blood pressure, heart rate, ventilation and blood lactate concentration (Karageorghis & Priest, 2012). Lastly, there are the *ergogenic* effects, which refer to performance levels, such as strength, endurance, power or productivity. Ergogenic effects are seen when there is an improvement in performance, perhaps due to delayed onset of fatigue or increased work capacity (Karageorghis & Priest, 2012).

1.2.5.1 Psychological Effects. In assessing the psychological effects of music during physical activity, research has investigated how music may play a role in the distraction and/or enhancement of feelings (Terry, Lane, Bishop, & Priest, 2012). Music has been shown to make physical activity more pleasurable by enhancing mood. Seath and Throw (1995) studied participants' mood during aerobic exercise over a 4-week period in 34 women and men. The aerobic routine consisted of 15 exercises, and utilized the large muscle groups and upper limb movements. Participants performed the same routine in either a music condition where pop music was played at 95 decibels measuring 132 bpm, or in a no-music condition, which used a metronome set at 132 bpm to keep time. Results indicated that there was a positive effect on mood in the music condition, with participants having greater feelings of pleasure during aerobic exercise in comparison to the no-music condition. Hutchinson, Karageorghis, and Jones (2014) supported these findings. The authors had 24 men and women complete a treadmill running task at 10% above and below their ventilatory threshold. Participants ran a total of three times: two experimental conditions (music-only and music-and-video) and a control condition (no-music, visually sterile). Participants ran for 15 minutes and a measure of state motivation was taken just before the 5, 10, and 15 minute marks. Post-test measures of affective valence (pleasure-displeasure) were taken. It was found that state motivation was significantly higher in the experimental conditions when compared to the control condition regardless of exercise intensity. Further, post-task measures of affective valence showed that positive affect was higher in the experimental conditions than in the control condition. Further, the music-and-video condition showed higher levels of affective response (i.e., pleasure) compared to the music only condition regardless of exercise intensity.

More support of the psychological effects of music was shown in a study comparing trained and untrained runners during treadmill exercise in three conditions (no-music, sedative music and fast music), during low, moderate and high intensity exercise. A sample of eight trained and eight untrained male and female runners completed bouts of exercise lasting 10-minutes at each exercise intensity. Although there was no difference based on music condition, results did report more positive affect in untrained runners compared to trained runners in all conditions. The researchers suggested that listening to fast, upbeat music was beneficial to untrained runners, but may hinder trained runners (Brownley, McMurray, & Hackney, 1995).

Moreover, Tenenbaum and colleagues (2004) also found support for positive psychological effects of music during physical activity in a series of three studies. In the first study, 15 male participants completed four treadmill-running tasks, once each to either rock, dance, inspirational or no-music. Measures of motivation were taken during the run along with measures of heart rate and perceived exertion. The second study was similar to the first study, with 15 male participants completing the same procedures to the different musical genres. In addition to motivation being recorded, participants' personal reflections were also documented. The last study was done in the field in order to determine if the laboratory findings were generalizable to more real-life contexts.

Although there were no significant differences in heart rate and perceived exertion between the groups, in the third study 30% of participants stated that inspirational music helped to motivate them and also direct their attention during the task.

A more recent study conducted by Stork, Kwan, Gibala, and Martin-Ginis (2015) investigated music's effect on performance and perceived enjoyment during sprint interval training. Twenty male and female participants underwent four, 30-second all out bouts of a Wingate anaerobic test in both a music and no-music condition, which were separated by four minutes of rest between each trial. Measures of power output, RPE, affect, and motivation were taken during the rest periods and perceived enjoyment was measured following the completion of the exercise session. Power output was greater in the music condition compared to the no-music condition. With respect to affect, there was no statistical difference between the music and no-music conditions. However, the authors noted that affect was rated the same during both conditions, even with the increase in workload (i.e., power output) in the music condition.

Contrary to these findings however, is research that suggests that music may have no psychological effects in physical activity settings. In a study of 26 male and female undergraduate students, data was collected to determine if there were differences in affect and endurance while performing circuit-training exercises in three music conditions: motivational, oudeterous (motivationally-neutral) and no-music control (metronome). There were no significant differences in affect across the three conditions (Karageorghis et al., 2010). Sanchez, Moss, Twist, and Karageorghis (2014) further supported these findings when looking at the role of lyrics and music during a cycling ergometer test. Twenty-five male and female undergraduate students completed a cycling ergometer trial at 75% maximal heart rate, once each in the two experimental conditions (music with lyrics and music without lyrics) and once in the no-music control condition. Psychological measures of positive and negative affect were recorded prior to and immediately after the trials. The results of this study showed no significant differences in affect between any of the conditions. Together, these studies indicate contradictory evidence for the psychological effects of music during physical activity.

1.2.5.2 Psychophysical Effects. Within the music and physical activity literature, psychophysical effects are assessed as self-reported ratings of effort using Borg's Rating of Perceived Exertion (RPE; Borg, 1982). Therefore the terms psychophysical and perceive exertion have become interchangeable in their meanings in this body of literature (Karageorghis & Priest, 2012). Music has been shown to have an effect on perceived exertion during physical activity. Szmedra and Bacharach (1998) conducted a study which had 10 well-trained male participants complete two 15-minute treadmill running tasks at 70% maximum volume of oxygen uptake (VO_2max), 72 hours apart. These tests were done either listening to popular classical music ("Hooked on Classics 3") or in a control condition where no music was played. Measures of RPE, plasma lactate, norepinephrine and cardiovascular hemodynamics were taken every three minutes. With respect to RPE, significant differences were seen at minutes 6, 9, 12 and 15, with the music condition reporting lower levels of perceived exertion at each time point. An average 10% decrease in perceived exertion was noted when exercising with music compared to exercising in the no-music condition.

Consistent with these findings was a study investigating the influence of exercise setting on RPE at low and high exercise intensities. Thirteen untrained male participants performed four 15-minute cycling sessions at 50% VO_2 peak (low intensity) and four sessions at 80% VO_2 peak (high intensity; Nethery, 2002). Participants were tested at each intensity under a control condition (standard laboratory environment), a sensory deprived condition (where all sensory information was removed), a video condition (where participants wore ear muffs and watched a video of amusing skiing situations), and a music condition (where participants wore opaque goggles while listening to motivational music). Under each condition and intensity researchers recorded RPE every five minutes. This study showed that at both low intensity (50% VO_2 peak) and high intensity (80% VO_2 peak), RPE was lower in the music condition when compared to all other conditions (Nethery, 2002).

Schwartz, Fernhall, and Plowman (1990) conducted one of the first experiments that did not find an effect of music on RPE during physical activity. Ten untrained male and 10 untrained female participants performed three bicycle ergometer tests, in each of two randomized conditions (fast tempo music or no-music), for a total of six experimental trials. Ratings of perceived exertion were taken every 3-minutes until exhaustion, which was defined as the inability to maintain the required cadence. Results of this study indicated that there was no significant difference in RPE for either gender or condition. Therefore the psychological perception of effort was not altered by the presence of music during sub-maximal exercise.

Added support for music having no effect on perceived exertion comes from Lim, Atkinson, Karageorghis, and Eubanks (2009) who examined the introduction and removal of music at different time points during cycling time trials. Eleven male participants performed a 10 kilometre time trial in three different conditions: no-music,

music played initially and then removed for kilometre 5-10, and music played during kilometre 5-10 only. Ratings of perceived exertion were recorded at 2.5 kilometres, 5 kilometres, 7.5 kilometres and 10 kilometres. It was concluded that there was no significant difference in RPE between the music conditions and no-music condition.

Stork and colleagues (2015) also assessed RPE in their study investigating music versus no-music during sprint interval training. In regards to RPE, the findings of this study were particularly interesting in that there were no statistical differences between the music and no-music conditions, with participants reporting equal RPE levels in both conditions. However, as noted previously, there was greater power output recorded in the music condition, which indicated that participants were indeed working harder when music was present. These findings indicate that perceptions of music's effects in altering psychophysical states may be less apparent when exercise intensities are increased. Given the mixed findings, the nature of the psychophysical effects of music on physical activity is still equivocal.

1.2.5.3 Physiological Effects. Less research has focused on the physiological effects of music during physical activity. It has been documented that music may affect some physiological functions such as heart rate due to the fact that both are rhythmically based (Hohler, 1989). Iwanaga (1995) hypothesized that there was a linear relationship between exercise heart rate and music tempo preference. This hypothesis was supported in a sample of 14 female participants, who reported preferring a music tempo that was closely matched to their heart rates.

Karageorghis, Jones, and Low (2006) found partial support for this hypothesis. One hundred and twenty-eight undergraduate students were surveyed to determine their favourite three music artists. Next, 29 male and female undergraduate students (who were not part of the initial music selection process) selected music from one of the top three artists determined through the initial survey and reported their preference for slow, medium and fast tempo while performing three treadmill walking tasks at 40%, 60% and 75% maximal heart rate reserve. Results showed that there was a preference for medium to fast tempo music at low and moderate exercise intensities, and that at high intensity there was a preference for fast tempo music, indicating partial support for the linear relationship between exercise heart rate and tempo preference.

In a study looking at the effects of music on hormone secretion during physical activity, 24 male participants were randomized into one of three experimental groups: no-music, slow music (130-140 bpm) and fast music (150-170 bpm). Participants performed 10 minutes of submaximal exercise on a bicycle ergometer and blood samples were collected before and after exercise. In the no-music group there was an increase in levels of cortisol and endorphins. In the music groups, there was a slow decline in the secretion of cortisol, while levels of endorphins fluctuated (Sugiharto, 2009). This study suggests that music may be a way to decrease the hormone cortisol, which is released in response to a stressor such as exercise.

More recent research that has looked into the physiological effects of music has shown that music may aid in recovery after physical activity. Eliakim, Bodner, Eliakim, Nemet, and Mackel (2012) noted that listening to motivational music post-exercise was associated with increased voluntary activity. Twenty male participants performed a peak oxygen consumption treadmill run for 6 minutes, on two separate counter-balanced occasions – once with and once without motivational music. Measures of heart rate, blood lactate and number of steps were recorded at the 3, 6, 9, 12 and 15-minute mark following the end of the treadmill run session during an unstructured recovery period. When listening to motivational music, participants registered an increase in the number of voluntary steps taken during the unstructured recovery period. This in turn led to significant decreases in blood lactate concentration and quicker recovery from intense exercise. These studies indicate that music can affect physiological responses within the context of physical activity.

Contrary to these findings is research that indicates that music has no physiological effects on physical activity. In a study conducted by Schwartz et al. (1990), 10 men and 10 women completed two submaximal cycling ergometer tests under the conditions of fast-tempo music and no-music, in randomized order. Heart rate was measured at each 3-minute interval, while data for oxygen consumption, respiratory exchange ratio, and minute ventilation were measured on a continuous basis and averaged into 1-minute time periods. Blood lactate data was collected immediately following exercise termination and again at 3 and 6 minutes post-exercise. The pre-set workload was calculated to be 75% of participant's maximum VO_2, and participants pedalled at a cadence of 50 rotations per minute (rpm). The test was finished once participants were not able to maintain the required cadence. The results of this study showed that music did not influence any of the physiological measures (heart rate, blood lactate, oxygen consumption, respiratory exchange ratio, and minute ventilation).

1.2.5.4 Ergogenic Effects. The ergogenic effects of music in physical activity are noted when there is a higher performance output on variables such as endurance, power and productivity (Karageorghis & Priest, 2012). Chtourou, Chaouachi, Chamari, and

Souissi (2012) investigated diurnal fluctuations in muscle power output during a Wingate test to determine if music played during the warm-up helped to overcome power output deficits in the morning. This hypothesis was based on findings that poorer performance in the morning is linked to lower levels of mood states and subjective sleepiness during early morning hours. Twelve male participants completed four separate Wingate tests. Tests were randomized, with two occurring in the morning (7:00-9:00) and two in the evening (17:00-19:00). The music condition included a 10-minute warm-up with music and the no-music condition included a 10-minute warm-up without music. Conditions were randomized as well. The results indicated that power output (both peak and mean) were significantly greater in the music condition than the no-music condition in both the morning and the evening trials. Also, music was associated with higher mean power output in the morning in comparison to the evening trials (Chtourou et al., 2012).

In a study conducted by Elliott, Carr, and Orme (2005), 18 untrained participants (10 males, 8 females) underwent a 20-minute submaximal cycling task in each of three conditions (motivational music, oudeterous music, and no-music). Distance travelled, in-task affect and RPE were recorded for each trial. In regards to distance, results indicated that there was a significant difference between both music conditions when compared to the no-music condition. When looking at the music conditions, there was no significant difference in distance travelled when differentiating between the two music groups. This study indicates that music does have an increased effect on performance during physical activity in comparison to no music.

Lim and colleagues (2009) reported more evidence for music's ergogenic effects. As noted previously, researchers looked at the introduction of music at various points during a 10-km cycling time trial. It was found that participants had an increased cadence (1-1.5km/hour faster) when music was played between 5-10 kilometres as opposed to when music was removed after the first 5 kilometres or when no music was present (Lim et al., 2009).

Although some researchers have advocated for the use of music as an ergogenic aid, there is also research to the contrary. In the previously mentioned study by Schwartz et al. (1990), in which participants performed a submaximal cycling ergometer test, exercise duration was measured. Although it was reported that exercise duration was greater in the music condition (mean = 25.60 minutes) versus the no-music condition (mean = 21.30 minutes), these results were not statistically different. Together, these findings illustrate that although there is some benefit to music's ergogenic effect on exercise performance, there is still evidence that is contradictory to this fact.

1.2.6 Why Mixed Findings of Music's Effects on Physical Activity Outcomes. As the above review of the research indicates, there are equivocal findings as to music's effects during physical activity for all types of outcomes: psychological (including psychophysical), physiological and ergogenic. One potential reason for these mixed findings may be due to the fact that the definition of motivational music was inconsistent throughout various studies (Karageorghis & Terry, 1997). With the use of the BMRI-2, researchers now have a standardized method for the selection of motivational music (Karageorghis, Priest et al., 2006), yet findings as to the effects of exercise on physical activity are still mixed.

A second potential reason may be due to the fact that the research has predominantly utilized experimenter-selected music, which removes input from the exerciser and therefore the music may lack personal meaning – important in both the cultural and associative characteristics of music. This experimenter-driven selection of music may negate individual differences such as age, personality type, fitness level and attentional style, which are key personal factors in music's effect on physical activity (See Figure 1). The influence of music is dependent upon the listening context (e.g., environment, mood) and the listener's experiences (e.g., emotional associations with specific songs; Karageorghis & Priest, 2012) and these personal factors should be taken into consideration when conducting research or when applying music to real-world physical activity interventions.

1.2.6.1 Self-Selected Music. The majority of research that has been conducted into the effects of music on exercise has focused on the use of experimenter-selected music that is chosen in advance (Biagini et al., 2012; Chtourou et al., 2012; Lim et al., 2009; Sugiharto, 2009). However, these studies fail to account for personal factors (e.g., age, personality type, frequency of exercise), which are antecedents that are hypothesized to contribute to the potential benefits of music's effect on physical activity (See Figure 1). In addition, the internal factors of the model (e.g., association) may be difficult for a researcher to account for, due to the individualistic nature of music taste and motivation. In a qualitative study done by Priest and Karageorghis (2008), researchers investigated the characteristics of music that may be beneficial during physical activity. Through semi-structured interviews, researchers noted that seven out of thirteen participants preferred self-selecting music when exercising, rather than having music provided for them.

Research has supported this point in regards to the selection of music in physical activity. In a study of perceived choice of music during physical activity, 34 female participants were randomized into a control group or an experimental group and performed a 25-minute aerobic session privately, using an exercise video (Dwyer, 1995). Women in the experimental group were led to believe that their music preferences may be used in the aerobic exercise video, although no songs preferred by the experimental group were actually included. The control group was given no input of music preference. Intrinsic motivation for aerobic dance was assessed after the completion of the physical activity session. It was found that participants in the experimental group reported higher intrinsic motivation scores when performing the aerobic dance session, perhaps due to the perception that they had some input into the music used in the making of the cassette (Dwyer, 1995)

There have been few studies that have looked explicitly at the effects of self-selected music on physical activity. In a study conducted by Biagini et al. (2012), 20 male participants performed jump squats and the bench press and completed measures of mood in both a self-selected music condition and a no-music condition. Participants performed three sets of bench press and jump squats (counter-balanced order). Mood and ratings of perceived exertion were measured at both pre- and post-exercise for each condition. Results showed that feelings of vigour and squat jump explosiveness in the self-selected music condition were significantly higher when compared to the no-music condition. However, negative mood variables of tension and fatigue were also higher in the self-selected condition in comparison to the no-music condition. The authors suggested that the higher measures of tension and fatigue might be due to the increased performance in squat jump explosiveness, as it would indicate that participants were performing at maximal effort in the self-selected music condition (Biagini et al. 2012). Moreover, there was no significant difference between conditions on bench press performance to failure, which may indicate that self-selected music might improve only acute power performance and mood, but not performance maintained over a period of time.

Although there has been some partial support for the use of self-selected music, there is also research that indicates no effect from the use of self-selected music. Hagen and colleagues (2013) performed an experiment where 18 well-trained male and female cyclists completed four 10-km cycling time trials with the use of self-selected music or with auditory input blocked. There were two trials performed for habituation, followed by two randomized experimental trials. Participants listened to self-selected music beginning 3 minutes before the start of one experimental trial; in the other experimental trial, there was a block to auditory input. Measures of heart rate, power output and time were recorded every 500 meters and averaged. A measure of blood lactate was recorded pre-exercise and at every 2-km interval of the time trial and RPE was recorded every 500 meters. The results indicated that self-selected music had no significant influence on power output, heart rate, lactate concentration or RPE in comparison to the absence of music. One explanation for this lack of difference was that this experiment used a close-loop task (in which participants complete a pre-specified amount of work) rather than an open-loop task (in which participants perform to exhaustion or some other self-determined amount of work). In closed-loop tasks (such as a time-trial) RPE increases in a linear fashion despite distance. It is possible that in a closed-looped task participants need to complete the exercise despite feelings of exhaustion, which may negate the benefits of self-selected music.

To date, there has been no study to directly compare self-selected music to researcher-selected music while utilizing adequate controls (i.e., a no-music group and a researcher-selected music group) in a physical activity setting. One study outside of physical activity has directly compared self-selected and researcher-selected music. Cassidy and MacDonald (2009) investigated performance during a driving task where 125 male and female participants performed three laps of a driving simulation game under five conditions (silence, car sounds alone, self-selected music, high-arousal music and low-arousal music). The high and the low-arousal music were researcher-selected. Three performance variables were measured (accuracy, time, speed) and five experience variables were measured (distraction, liking, appropriateness, enjoyment and tension-anxiety). It was found that participants in the self-selected music group reported the highest enjoyment, liking, and appropriateness of the music. This group also perceived the lowest distraction and reported a reduction in tension-anxiety. In comparison, the researcher-selected high-arousal music condition was associated with the poorest accuracy, highest distraction, lowest enjoyment, liking and appropriateness and an increase in tension-anxiety (Cassidy & McDonald, 2009)

1.2.7 Summary

Within the literature there are mixed findings regarding the effect of music on physical activity outcomes (Karageorghis & Terry, 1997). Even within the self-selected music literature, there have been mixed findings (Biagini, 2012; Hagen et al., 2013). There are several potential reasons for this lack of consistency. First, the operational definition of the term “self-selected” is varied, with different methods for participants to “self-select” their music. Some selection processes allow participants to pick from a list of predetermined motivational music (Hutchinson et al., 2014) while others are based solely on individual preference (Hagen et al., 2013), or the participant is led to believe that his/her choice will be used, however, only the perception of choice is given (Dwyer, 1995). To date, no study has investigated the use of self-selected music in comparison to researcher-selected music in regards to its psychological, physiological and ergogenic effects on physical activity. Also, to date, while several outcomes have been investigated, no study has looked at the effects of self-selected music on intrinsic motivation, a key barrier to physical activity participation.

CHAPTER 2: RATIONALE, PURPOSE, & HYPOTHESIS

2.1 Rationale

Research has suggested that motivational music may influence physical activity in at least three types of ways, including psychological effects (which includes psychophysical effects), physiological effects and ergogenic effects (Karageorghis & Terry, 1999). Several studies have examined the effects of motivational music in an exercise setting on a number of variables including the psychological variables of mood (Seath & Throw, 1995), enjoyment (Dyrlund & Wininger, 2008), affect (Brownley et al., 1995; Hutchinson et al., 2014; Karageorghis et al., 2010; Sanchez et al. 2014) and motivation (Tenenbaum et al., 2004), as well as RPE (Schwartz et al., 1990; Szmedra & Bacharach, 1998). Physiological variables including heart rate, hormone secretion, blood lactate (Eliakim et al., 2012; Karageorghis, Jones et al., 2006; Sugiharto, 2009) and ergogenic variables including power output, cadence, and time (Chtourou et al., 2012; Lim et al., 2009) have also been investigated. Across these studies, the effect of music during physical activity has been equivocal, with some studies finding positive effects of music, and others finding no influence of music. One potential explanation for these equivocal findings may be the way in which music has been selected in the majority of studies. While music used in most studies has been considered motivational according to criteria by Karageorghis, Priest et al. (2006), it is also predominantly researcher-selected.

As music's influence may rely on the listening context, experiences, and preferences of the listener (Karageorghis & Priest, 2012), it is important to address these factors during physical activity and scientific investigation. According to the adapted model of responses to music and potential benefits (see Figure 1 – Karageorghis & Priest, 2012), personal factors (cultural impact and association) and music characteristics (i.e., rhythm response and musicality) play a role in whether or not music is categorized as motivational. While it is relatively easy for a researcher to classify the objective music characteristics (i.e., using an instrument such as the BMRI-2) as more or less motivational, it may be more challenging to identify what music is personally more motivational – that is, what music has personal associations or cultural relevance to varying individuals. The use of self-selected music may be one way to address these personal factors. By allowing exercisers and athletes to choose their own music, cultural impact and personal associations could be increased, perhaps increasing the motivational impact of music, thus attaining potential benefits of music on physical activity outcomes.

Few studies have investigated whether allowing the participant to choose his/her own music impacts physical activity outcomes. Dwyer (1995) investigated perceived choice on intrinsic motivation during physical activity, where participants were led to believe that their music selections would be used in an aerobic dance cassette during a physical activity session. Although this experiment did show increases in intrinsic motivation for the perceived choice group, it did not actually use any of the participants' selected music. Perhaps being given actual choice in music selection through the use of self-selecting music may be more motivational than perceived choice in relation to physical activity

The use of self-selected music has been utilized by a handful of studies (Biagini et al., 2012; Hagen et al., 2013). Biagini and colleagues (2012) investigated the effects of self-selected music versus no-music on mood and performance during a bench press and squat jump performance task. It was found that squat jump explosiveness was greater in the self-selected music condition when compared to the no-music condition. This study indicated that there was improved performance when listening to self-selected music during explosive exercise compared to no-music, and the authors suggested that self-selected music is beneficial for acute power performance. Hagen et al. (2013) also investigated the use of self-selected music against blocked auditory input during physical activity and concluded that there was no difference between groups during closed-looped cycling time trials on time, power output, heart rate blood lactate or RPE.

However, there are limitations to these studies. Although both studies allowed participants to self-select their own music, there was no comparable researcher-selected music condition. Both studies utilized a no-music control as the only other condition, which limits the implications of the self-selected music condition. Due to the fact that there was no direct comparison of self-selected to researcher-selected music, findings may be due to the presence of music in general and not necessarily to the self-selected nature of the music. Thus, it is important to determine if there is a difference between the two music conditions while using an adequate control group.

Outside the realm of physical activity, Cassidy and MacDonald (2009) investigated the effects of self-selected and researcher-selected music on performance during a driving task. They found that participants in the self-selected music group reported the highest enjoyment, liking, and appropriateness of the music, while perceiving the lowest distraction and reported a reduction in tension-anxiety. In comparison, the researcher-selected high-arousal music condition was associated with the poorest accuracy, highest distraction, lowest enjoyment, liking and appropriateness, and an increase in tension-anxiety (Cassidy & McDonald, 2009).

Given the mixed findings of the effects of music on physical activity outcomes, including findings on self-selected music, it is important to examine factors that could account for these conflicting findings. While in a driving task there is evidence for the beneficial effects of self-selected music over researcher-selected music, in physical activity settings it is less clear. This is an important area of inquiry as it may help researchers to understand if personal factors (as outlined in the model) may play a more important role in music's effect on physical activity. Furthermore, if self-selected music does lead to better outcomes, this information could be used to help increase motivation, enjoyment, and adherence, and improve the effectiveness of physical activity interventions through the use of self-selected music (e.g., in fitness centres or rehabilitation settings), which would be a simple and inexpensive approach.

2.2 Purpose

In this study, the type of music (self-selected versus researcher-selected) during a treadmill running task was manipulated to assess differences in psychological (intrinsic motivation and enjoyment), psychophysical (RPE), physiological (heart rate), and ergogenic (distance) outcomes.

The specific research questions that were answered are as follows:

1. Does self-selected music result in higher intrinsic motivation during a treadmill running task in comparison to researcher-selected motivational music or no-music?
2. Does self-selected music result in higher enjoyment during a treadmill running task in comparison to researcher-selected motivational music or no-music?
3. Does self-selected music result in higher RPE during a treadmill running task in

comparison to researcher-selected motivational music or no-music?

4. Does self-selected music result in lower heart rate during a treadmill running task in comparison to researcher-selected motivational music or no-music?
5. Does self-selected music result in running a longer distance during a treadmill running task in comparison to researcher-selected motivational music or no-music?

2.3 Hypotheses

The following hypotheses were made for the self-selected condition in relation to the researcher-selected and control condition:

1. Intrinsic motivation would be higher in the self-selected music group in comparison to either the researcher-selected music group or the control group. This hypothesis was made based on previous research conducted by Dwyer (1995) which showed that the perceived choice of music led to higher intrinsic motivation during an aerobic exercise class compared to no choice at all. In the current study, the autonomy of choosing one's own music should lead to greater intrinsic motivation.
2. Enjoyment would be higher in the self-selected music group in comparison to either the researcher-selected music group or the control group. This is based on previous research by Cassidy and MacDonald (2009) showing that a self-selected music condition resulted in greater enjoyment during a driving simulation task when compared to 4 other conditions (silence, car sounds alone, high-arousal music and low-arousal music).
3. Ratings of perceived exertion would be higher in the self-selected music group in comparison to either the researcher-selected music group or the control group. This hypothesis is based on research by Stork et al. (2015), who found no difference in

rating of perceived exertion during a music condition, despite the fact that they generated greater power output (i.e., worked harder as measured objectively) during sprint interval training.

4. Distance run would be greater in the self-selected music group in comparison to either the researcher-selected group or the control group. This was based on the conceptual model of music effects on physical activity (Karageorghis & Priest, 2012), which indicates that performance may increase under motivational music. Moreover, according to this model, music that heightens personal association (as should be the case when music is selected by the individual) should foster greater motivation, which may translate to greater effort and ultimately improved performance.
5. Heart rate would be lower in the self-selected music group in comparison to either the researcher-selected music but lower than the control group. This was hypothesized based on research by Iwanaga (1995), which indicated that the relationship between music and heart rate might be influenced by the meaning of the stimuli (i.e., the music presented). It was hypothesized that the participant's own music would have a calming effect due it its familiarity, causing heart rate to be lower when compared to the research-selected or no-music condition.

Further, based on the conceptual model (Karageorghis & Priest, 2012), it was also hypothesized that compared to the control condition:

1. Intrinsic motivation would be higher in the researcher-selected condition.
2. Enjoyment would be higher in the researcher-selected condition.

3. RPE would be higher in the researcher-selected condition.
4. Distance values would be greater in the researcher-selected condition
5. Heart rate would be lower in the researcher-selected condition.

2.4 Assumptions

1. All participants would select music that is preferred by them within the context of physical activity.
2. Counterbalanced order of conditions would negate the learning effect that may have been present.
3. All participants would be naïve to the true purpose of the study.
4. Participants would answer all questions accurately and honestly.
5. Participants would not be influenced by the presence of the experimenter within the testing environment
6. The testing protocol would be consistent across all conditions and from participant to participant.

2.5 Delimitations

1. This study included only college-aged participants ranging in age from 17-35.
2. All participants of this study were volunteers.
3. Only music selection was be manipulated in order to determine its effect on the aforementioned variables.
4. This study would only measure some variables that may be impacted by music type

2.6 Limitations

1. Due to the fact that only college aged persons (17-25) participated in this study, the results were only be generalizable to this specific demographic.
2. Since this study was done on a volunteer basis, it was not randomly sampled from the population
3. Other factors (researcher presence, prior physical activity, time of day) may have impacted variables that were measured.
4. Other outcomes may have been influenced by music type, that were not included in this study (e.g., mood, body image)

CHAPTER 3: METHODOLOGY

3.1 Participants

Thirty participants (male and female) were recruited for this study. Previous literature (Elliot, Carr, & Orme, 2005) using a similar design to assess music's effects on RPE, distance, in-task affect and post-test attitudes found medium to large effect sizes (ES). These findings were based on a repeated measures design, with participants performing a 20-minute submaximal cycling task to no-music, oudeterous (non-motivational) music, and motivational music. Sample size calculations, with power = 0.80 and $\alpha = 0.05$, indicated the recommended sample size to be 21 (large ES) participants per group for an ANOVA with three groups (Cohen, 1988). Given the slightly different manipulation compared to Elliot et al. (2005; i.e., researcher-selected vs. self-selected music), the repeated measures design, and practical considerations (attrition, data collection problems), approximately 30 participants were recruited.

Participants were recruited via announcements made in undergraduate classes (see Appendix A for verbal script) and posters placed around the Brock University campus (Appendix B). Participants were college men and women, as no gender differences have been reported in previous research (Hutchinson & Karageorghis, 2014; Karageorghis et al., 1996; Karageorghis, Jones et al., 2006; Karageorghis et al., 2008), between the ages of 18 and 35 from the Brock University community. All participants were able to engage in prolonged physical activity. Individuals diagnosed with a hearing disability were excluded from this study, as music was the primary manipulation of the current study.

3.2 Measures

Participants initially completed a physical activity clearance and demographic information questionnaire and a measure of physical activity. Following the physical activity, participants completed post-test measures of enjoyment, intrinsic motivation, (psychological outcomes) and perceived exertion (psychophysical outcome). Heart rate (physiological outcome) and distance (performance outcome) were also measured and recorded following each run.

3.2.1 Initial Questionnaires. The baseline questionnaire consisted of the Physical Activity Readiness Questionnaire (PAR-Q), a demographics questionnaire and the International Physical Activity Questionnaire – Short Version (IPAQ-S, 2010).

3.2.1.1 Physical Activity Readiness Questionnaire. The PAR-Q (CSEP, 2002; Appendix C) consists of seven "yes" or "no" questions related to one's overall health status, and was used as clearance for physical activity. Participants who answered "no" to all questions were permitted to take part in the study. If a participant selected "yes" to one or more of the questions, that participant was not eligible to participate in the study.

3.2.1.2 Demographics. Participants self-reported age, height, weight, year in school, major and gender as part of their demographics questionnaire, as well as listing the types of physical activity that they engaged in, and any medical conditions or medication they may have used. (see Appendix D).

3.2.1.3 International Physical Activity Questionnaire – Short Version. The IPAQ-S (Craig et al., 2003; Appendix E) is a six-item questionnaire that assessed the amount of moderate, vigorous, and walking type physical activity that had been done in the last 7 days. Participants recorded how many days during the previous week that they engaged in each of vigorous, moderate and walking-type physical activity for at least 15 minutes, as well as, on average, how long they performed each intensity of physical activity during an average day. For each intensity of exercise, the number of sessions per week was multiplied by the average time per session to get a total time per week. Then, each intensity level was multiplied by the known metabolic equivalent of the task (MET; i.e., for walking-type physical activity, 3.3METs; for moderate intensity activity, 4.0METs; and for vigorous intensity activity, 8.0METs). These values were then summed to give a total score in MET minutes per week (Patterson, 2010). For the purposes of this study, only moderate and vigorous intensity physical activity values were used, consistent with Canadian physical activity guidelines (CSEP, 2012). Other studies have used the IPAQ-S to assess physical activity levels (Rosemann, Kuehlein, Laux, & Szecsenyi, 2007); acceptable reliability and validity have been established for the instrument (Craig et al., 2003).

3.2.2 Intrinsic Motivation Inventory (IMI). Ryan (1982) created the 75-item IMI to assess participant's interest-enjoyment, competence, effort-importance, value-usefulness, pressure-tension, and choice towards specific tasks (e.g., physical activity). For the purpose of this study, the interest-enjoyment subscale (Appendix F) was used to reflect intrinsic motivation during the running task. This subscale consisted of twelve items, for which participants indicated on a scale from 1 = *not at all true* to 7 = *very true* their interest/enjoyment towards the run they had just completed (e.g., "this activity was fun do to"). Consistent with instructions by the authors, items were worded specifically to reflect the completed run. Evidence of reliability and validity has been provided for the use of the IMI within physical activity settings (McAuley, Duncan, & Tammen, 1989).

3.2.3 Physical Activity Enjoyment Scale (PACES). Enjoyment of physical activity was assessed using the PACES (Kendzierski & DeCarlo, 1991; Appendix G). The PACES is an 18-item questionnaire. Each item is rated on a 7-point bipolar rating scale, which assessed state enjoyment towards physical activity completed. A sample question was "Please rate how you feel at the moment about the physical activity you have just completed?" with responses ranging from 1 = *I felt good physically while doing it* to 7 = *I felt bad physically while doing it* (Kendzierski & DeCarlo, 1991). For the purposes of this study a revised version of the PACES was used, utilizing eight questions to assess state enjoyment of the activity participants had completed. Higher scores represented higher levels of enjoyment. Evidence of reliability for this revised version was found in a sample of female college students performing aerobic exercise. The eight items selected were highly correlated with the complete PACES scale (r = .94), meaning that the deleted items did not severely impact the scales reliability (Raedeke, 2007).

3.2.4 Rate of Perceived Exertion. To assess the psychophysical variable of RPE, Borg's (1998) RPE scale was used (see Appendix H). This widely used scale assessed how hard an individual believed that he or she was working. RPE is measured on a 10-point scale, ranging from 0 = *nothing at all* to 10 = *very, very strong to maximal*. Participants indicated how hard they felt they were working after each run as a measure of perceived exertion.

3.2.5 Heart Rate. Heart rate was taken using the OMRON BP742 ® blood pressure cuff and heart rate monitor. The cuff was placed over the left arm and activated, after being fully pressurized, the display screen read out blood pressure as well as heart rate. Heart rate was taken at two points; resting heart rate once participants had filled out the preliminary questionnaires and immediately post-exercise by the experimenter.

3.2.6 Distance. Distance was used as the indicator of physical performance. Distance was measured to the nearest 1/10 mile using the value displayed on the treadmill. The experimenter recorded total distance run at the end of each condition.

3.3 Study Design

This study design was a repeated measures design. It consisted of three visits, where participants performed a 30-minute treadmill running task in each of the conditions (self-selected music, researcher-selected music, and no-music control). Conditions were randomized and participants were unaware of the true purpose of the study. Measures were assessed post-run, with the exception of heart rate, to avoid priming participants.

3.4 Cover Story

To reduce demand characteristics, participants were blinded to the true purpose of the study. Participants were recruited to participate in a study investigating the relationships between personal characteristics and attitudes towards physical activity during a running task. To bolster the cover story a series of questionnaires were added to the questionnaire package to draw attention away from the intended purpose of the study examining music's effect on physical activity. The added questionnaires consisted of items from the Rosenberg Self-Esteem Scale (Rosenberg, 1965), the Reasons for Exercise Inventory (REI; Silberstein, Striegel-Moore, Timko, & Rodin, 1988), and the Task Self-Efficacy Scale (Bandura 2006). Participants filled out these questionnaires during their initial visit as part of the baseline questionnaire package, but no data from these questionnaires was analysed.

3.5 Procedures

Ethics clearance was obtained from the Research Ethics Board at Brock University prior to the beginning of the study (Appendix I). Interested individuals were asked to contact the researcher via email. They received a letter of invitation (Appendix J) via email, which highlighted inclusion/exclusion criteria for the proposed study. The researcher responded to any questions from the participant at this time. After the participant had agreed to participate in the study, a mutually convenient time and date was determined for the first visit. The participant was asked to email the researcher with a list of his/her preferred music when participating in physical activity (i.e., running). To disguise the true nature of the study, participants were under the impression that the purpose of the study was to investigate the relationship between personal characteristics and attitudes and how this influences running and physical activity behaviour in order to draw attention away from the music. If participants asked about the purpose of the playlist, they were informed that a list of songs was being compiled from all participants as part of the overall study design. After this, participants were asked to meet at the Exercise Intervention Lab (Welch Hall 16) on the Brock University campus, already changed into clothing that was appropriate for engaging in physical activity. Prior to their arrival, the participants were randomly assigned to the order in which they would be performing each condition (self-selected, researcher-selected, no-music control) by the researcher without the participant's knowledge (see below for description of conditions).

Once in the lab, participants provided informed consent (Appendix K) and completed the PAR-Q. Participants who indicated "yes" to one or more questions were excluded from further participation in the study as they were not be cleared to engage in physical activity, however, all participants were cleared to participate. Next, participants completed the demographic questionnaire and the measures to uphold the cover story (self-esteem scale, exercise motivation and task self-efficacy), and resting heart rate was taken. At this point the researcher went go over the protocol.

3.5.1 Testing Protocol. All sessions were separated by at least 48 hours to ensure that the participant was fully recovered. Also, each testing session was done at approximately the same time of day in order to control for conflicts (class, work) or extraneous variables (diet, other physical activity). For all conditions, distance and speed displays were covered on the treadmill so participants would not be able to see their speed or distance while running. However, participants were able to see the time and were able to increase or decrease their speed whenever they wished. To ensure safety, all sessions started with participants performing a 5-minute warm up at a treadmill speed set between 3.5-4.5km/h (based on their personal preference) as recommended by previous research (Hutchinson et al., 2014), and at 0% incline. After the warm-up, music was turned on in the two experimental conditions, and participants were instructed to walk/run at their own pace, covering as much distance as possible within the 30-minute period. The researcher then moved to the office located inside the lab and there was no interaction between the researcher and participants until the run was completed.

Immediately following the 30-minute walk/run, the music was turned off in the music conditions, and the researcher recorded distance from the treadmill display and post run heart rate was taken. Participants then reported their rate of perceived exertion. Following this, participants completed the post-test questionnaires (PACES, IMI) to reflect the walk/run just performed. Questionnaires were counter balanced in order to avoid order effects.

Once these measures were completed, the researcher and participant scheduled a second appointment (at least 48 hours later) to conduct the same procedures in one of the remaining conditions. During the second session, participants began with the warm-up after which they conducted another 30-minute walk/run in one of the two remaining conditions. Again participants were not able to see their distance or speed but were able to adjust their speed whenever they saw fit. Immediately after the walk/run, the music was turned off in the music conditions, and the researcher recorded distance from the treadmill display, post-run heart rate was taken, and participants reported RPE. Participants then filled out post-task questionnaires (PACES, IMI) and scheduled their third and final visit to perform the task in the final condition.

Upon arrival for the final condition, participants warmed up for 5-minutes, conducted a 30-minute walk/run in the final condition without being able to see their distance or speed but were able to adjust speed. Immediately following completion of the task, the music was turned off in the music conditions, and the researcher recorded distance from the treadmill display, post run heart rate was taken, and participants reported RPE. Lastly, participants completed post-test questionnaires (PACES, IMI). At the end of the final testing session, participants were debriefed (Appendix L) on the true purpose of the study and received their performance values of distance, HR and RPE (Appendix M) for each condition. Final consent was obtained from the participant by the researcher (Appendix N).

3.5.2 Experimental Conditions. This study consisted of three experimental conditions: self-selected music, researcher-selected music, and no-music control.

Participants completed all three conditions and conditions were counter-balanced.

3.5.3 Self-Selected Music Condition. Participants provided a list of songs that they preferred running to and this was emailed to the researcher prior to the initial visit. If questioned, it was told to participants that the researchers were compiling music as part of a larger collection of songs that may be used during the testing sessions. In the self-selected music condition, the list of songs provided by the participant was played in a random order in order to negate any pre-existing order effects.

3.5.4 Researcher-Selected Music Condition. In this condition, a playlist of songs was selected by the researcher, based on the motivational criteria defined by the BMRI-2 (Karageorghis, Priest, et al., 2006. Song selections were taken from the last five years in order to increase their cultural relevancy. All participants heard this playlist in the same order during this condition. Any overlapping songs on participant's self-selected playlist were replaced on the researcher-selected playlist with another song that classified as motivational by the BMRI-2.

3.5.5 No-Music Condition. In this group participants completed the 30-minute walk/run in the absence of music. In order to maintain the cover story of study, participants performing the no-music control condition were informed that there were technical difficulties with the audio system and that it would be fixed at the earliest convenience.

3.5.6 Music Delivery. Music for all experimental conditions was delivered from an iPod ™, which was connected to a BOSE ™ surround sound speaker system. Volume was set at the same level for each participant by the researcher. As well, the system was placed in the same location for each of the music conditions for all participants. This ensured that sound delivery was consistent throughout all trials. Music was played at the same volume for each trial at 75 decibels, as previous research has indicated that sound above 75 decibels delivered during exercise may cause temporary hearing loss (Alessio & Hutchinson, 1991). Beats per minute (bpm) were measured for both music conditions using the Mixx audio program. There was no significant difference in bpm between the self-selected (113.8 bpm) and researcher-selected (116.35 bpm) conditions.

3.6 Data Screening

All data was analyzed using SPSS 20.0.

3.6.1 Check for Inaccurate Values. All items were screened for inaccurate values. A frequency count was conducted and data was visually screened to ensure each value was plausible. If values did not appear plausible, the original data was revisited to obtain the correct value. This value was then substituted for the inaccurate value.

3.6.2 Treatment of Missing Data. Missing data was visually screened. If data from an entire questionnaire (PACES, IMI, RPE) was missing, the participant's data was not used for any of the analyses involving that questionnaire. Where there were specific items missing, visual inspection determined the pattern and quality of the missing items, to ensure any missing data was random in nature.

3.6.3 Subscale Scores. Items were reversed scored where appropriate. Subscale scores were calculated using the mean score for enjoyment, and intrinsic motivation, such that higher scores represent higher levels of each construct. Scoring for the IPAQ-S was conducted as outlined above (see Measures section)

3.6.4 Univariate Outliers. Univariate outliers are cases with an extreme value on one variable (Tabachnick & Fidell, 2007). Among continuous variables, univariate outliers are cases with very large standardized values (*z*-scores) and that were disconnected from the other *z*-scores. Values with a standardized score (z-score) in excess of ± 3.29 ($p < .001$, two-tailed test) were investigated as possible univariate outliers (Tabachnick & Fidell, 2007). If there were outliers then cases were either deleted, or the influence of the outliers were minimized to where it was still the most extreme value, but its impact was lessened.

3.7. Testing Assumptions

All data was screened to ensure that the assumptions of the main analysis were met. These include the assumptions of normality and sphericity.

3.7.1 Normality. Means and standard deviations of the data were calculated along with values of skewness and kurtosis, as they are important aspects to the normality of a distribution. Kurtosis is a measure peakedness of the distribution, while skewness is a measure of the symmetry of the distribution (Tabachnick & Fidell, 2007). When a distribution is normal, the values of skewness and kurtosis are zero. Normality was assessed by significance tests (kurtosis ÷ standard error of kurtosis and skewness ÷ standard error of skewness) described by Tabachnick and Fidell (2007).

3.7.2 Sphericity. The assumption of sphericity states that the variances of the differences between all possible combinations of groups (i.e., levels of the independent variables) are approximately equal. If these variances were not approximately equal in value then this assumption would be violated. Mauchly's test of sphericity was used to indicate whether the assumption of sphericity was violated ($p < 0.05$). If sphericity was shown to be violated, then Greenhouse-Geisser adjustment was interpreted for the "Within-Subjects Effects".

3.8 Hypothesis Testing

3.8.1 Covariate Identification. Physical activity scores on the IPAQ-S, age and gender were investigated as possible covariates by examining bivariate correlations with the dependent variables. If any correlation were significant, the variables were used as covariates and, where applicable, analysis was changed to an ANCOVA instead of an ANOVA.

3.8.2 Research Questions. To examine the hypotheses that were stated, several repeated measures ANOVAs were conducted, with condition (self-selected, researcher-selected, no-music) as the independent variable and the appropriate dependent variable (intrinsic motivation, enjoyment, RPE, distance and heart rate). In a significant ANOVA analysis, Tukey post-hoc analysis was run to identify where the significant differences lay between groups, with an alpha level set at $p = .05$ for all tests.

CHAPTER 4: RESULTS

4.1 Treatment of Missing Data

Data was entered into SPSS 21.0 and visually screened for missing variables and implausible values. Less than 5% of the data was missing and there were no consistent pattern, therefore, an appropriate subgroup mean was used as a substitute for the missing items (Tabachnick & Fidell, 2007).

4.2 Subscale Scoring

Mean scores were calculated for IMI and PACES. A continuous score for physical activity recorded in MET-minutes/week was calculated using the physical activity scores over the previous 7 days for each participant using the IPAQ-Short scoring protocol (Patterson, 2010). To begin, all scores exceeding 180 minutes were recoded to a maximum value of 180 (according to the IPAQ scoring protocol); there were a total of 7 items that were recoded. Next, a MET value of 3.3 was assigned to walking physical activity, 4.0 METs for moderate physical activity and 8.0 METs for vigorous physical activity. A total moderate and vigorous MET-minutes/week value was calculated as described in chapter 3.

4.2.1 Univariate Outliers. Univariate outliers are defined as any value that falls outside the range of three standard deviations from the mean. To identify any outliers, z-scores for each variable were calculated. Any z-score outside the range of ±3.29, was identified as a potential outlier. There were no outliers identified within the dataset.

4.3 Assumptions

4.3.1 Normality. For each of the continuous variables (age, height, weight, physical activity, IM, enjoyment, RPE, HR and distance), univariate normality of each variable's distribution was assessed. First, histograms were generated to visually scan for any deviations from the bell-shaped curve of a normal distribution, to ensure that the mean was an adequate representation of the data, that the distribution was unimodal and that there were no possible outliers (Tabachnick & Fidell, 2007). As well, the values for skewness and kurtosis were calculated. All values fell within the range of ± 2.0, which indicates that no distribution was extremely positively or negatively skewed or extremely lepokurtotic or platykurtotic. Thus, the assumption of univariate normality was met.

4.3.2 Sphericity. In order to ensure that the variance of the differences between all possible combinations of groups (i.e., levels of the independent variables) were approximately equal, Mauchley's test of sphericity was conducted for each dependent variable. All dependent variables with the exception of heart rate had p-values greater than .05, indicating that this assumption was met. Due to the fact that the assumption of sphericity was not met for heart rate, a Greenhouse-Geisser adjustment was used for analysis for this variable.

4.4 Descriptive Information

4.4.1 Descriptive Statistics. Means and standard deviations were calculated for the sample and are reported in Table 1.

4.4.2 Correlations. Bivariate correlations were also conducted between all dependent variables and demographic variables (e.g., gender, age, weight) to determine if there were any possible covariates that should be accounted for during the hypothesis testing. There were no significant correlations found.

Table 1

Demographic Characteristics of Sample (n = 30)

	Sample			
Variable	Mean	SD	Skewness	Kurtosis
Age (years)	22.10	1.49	0.15	-1.12
Weight (lbs)	152.87	25.01	0.20	-0.15
Height (inches)	66.97	3.77	0.35	-0.69
BMI	23.79	2.16	-0.40	-0.83
Mod/Vig PA (MET-min/week)	4919.20	2979.22	0.88	-0.49
Total PA (MET-min/week)	7268.25	3792.51	0.60	-0.62

Note. Mod/Vig PA = Total moderate and vigorous physical activity per week. Total PA = Total walking, moderate and vigorous physical activity per week.

Table 2

Means and Standard Deviations (SD) per Condition

	Self-Selected Music (n = 30)				Researcher-Selected Music (n = 30)				Control (n = 30)			
Variable	Mean	SD	Skewness	Kurtosis	Mean	SD	Skewness	Kurtosis	Mean	SD	Skewness	Kurtosis
IM	5.31_a	0.79	-0.42	1.23	4.77_b	1.15	-0.48	-0.53	4.36_b	1.20	-0.64	0.58
Enjoy	5.09_a	0.91	-0.70	1.32	4.63	1.36	-0.71	-0.29	4.19_b	1.27	-0.54	0.31
Δ HR (bpm)	47.00	17.22	-0.33	0.22	47.53	17.02	-0.16	0.01	50.63	21.08	0.67	1.13
RPE	6.57_a	1.99	0.04	-1.46	5.83_b	1.97	0.10	-1.50	5.40_b	2.06	0.18	-1.22
Distance (miles)	3.32_a	0.54	0.16	0.33	3.06_b	0.53	-0.34	0.02	2.95_b	0.59	-0.26	-0.10

Note. IMI = Intrinsic Motivation Inventory was measured on a 7-point Likert scale (*1 = Not at all True* to *7 = Very True)*, PACES = Physical Activity Enjoyment Scale was measured on a 7-point bi-polar rating scale, RPE = Rating of Perceived Exertion was measured on a 12 point scale [*(0 = Nothing at all* to *10 = Very, Very Hard (Maximal)]*, BPM = beats per minute was the average beats per minute of each playlist. Different subscripts in a row indicate significant differences ($p < .05$)

4.5 Hypothesis Testing

4.5.1 Hypothesis 1: Intrinsic motivation would be higher in the self-selected music condition in comparison to the researcher-selected and no-music condition

The results of the repeated measures ANOVA showed that there was a significant within-subjects effect for condition, $F(2, 28) = 8.78$, $p = .001$, $\eta^2 = 0.23$. Follow-up Tukey post-hoc pairwise comparisons were then conducted to determine where the differences lay. Analysis revealed that intrinsic motivation was significantly greater in the self-selected music condition in comparison to the researcher-selected ($p = .014$) and no-music control condition ($p = .001$). There was no difference in intrinsic motivation between the researcher-selected music condition and the no-music control ($p = .09$).

4.5.2 Hypothesis 2: Enjoyment would be higher in the self-selected music condition in comparison to the researcher-selected and no-music condition. The results of the repeated measures ANOVA showed that there was a significant within-subjects effect for condition, $F(2, 28) = 6.59$, $p = .003$, $\eta^2 = 0.19$. Follow-up Tukey post-hoc pairwise comparisons were then conducted to determine where differences lay. Analysis revealed that enjoyment was significantly greater in the self-selected music condition in comparison to the control condition ($p = .001$). However there were no significant differences in enjoyment between the self-selected music condition and the researcher-selected music condition ($p = .09$), or between the researcher-selected music condition and the no-music condition ($p = .09$).

4.5.3 Hypothesis 3: Perceived exertion would be higher in the self-selected music condition in comparison to the researcher-selected and no-music condition. The results of the repeated measures ANOVA showed that there was a significant within-subjects effect for condition, $F(2, 28) = 6.59$, $p = .003$, $\eta^2 = 0.19$. Follow-up Tukey post-hoc comparisons were then conducted to determine where the differences lay. Analysis revealed that rating of perceived exertion was significantly greater in the self-selected music condition in comparison to the researcher-selected ($p = .03$) and no-music control condition ($p = .004$). There was no difference in perceived exertion between the researcher-selected music condition and the no-music control ($p = .11$).

4.5.4 Hypothesis 4: Distance would be greater in the self-selected music condition in comparison to the researcher-selected and no-music condition. The results of the repeated measures ANOVA showed that there was a significant within-subjects effect for condition, $F(2, 28) = 17.31$, $p = .001$, $\eta^2 = 0.37$. Follow-up Tukey post-hoc pairwise comparisons were then conducted to determine where the differences lay. Analysis revealed that distance was significantly greater in the self-selected music condition in comparison to the researcher-selected ($p = .001$) and no-music control condition ($p = .001$). There was no difference in distance between the researcher-selected music condition and the no-music control ($p = .08$).

4.5.5 Hypothesis 5: Heart rate would be lower in the self-selected music condition in comparison to the researcher-selected and no-music condition. Due to the violation of the assumption of sphericity, the Greenhouse-Geiser adjustment was used to interpret the findings on heart rate. The results of the repeated measures ANOVA showed that there were no differences in heart rate, $F(1.46, 28) = .73$, $p = .49$, $\eta^2 = 0.02$.

CHAPTER 5: DISCUSSION

The purpose of the present study was to examine the effects of music during a running task. More specifically it determined if there were any differences in psychological, physiological and performance outcomes between a self-selected music, researcher-selected music and a no-music condition. Overall, results showed that during the self-selected music condition participants reported more positive outcomes than when performing the running task in the researcher-selected and no-music control conditions.

5.1 Hypothesis 1: The Effect of Music Type on Intrinsic Motivation

It was hypothesized that intrinsic motivation would be higher following the self-selected music condition in comparison to the researcher-selected and no-music conditions. The results revealed that intrinsic motivation was significantly greater following the self-selected music condition than either the researcher-selected condition or the no-music control condition. There was no significant difference in intrinsic motivation between the researcher-selected condition and the no-music condition.

In comparison to previous literature, these findings are partially consistent. Although this is the first study to directly investigate the effects of self-selected music on intrinsic motivation, Tenenbaum et al. (2004) examined enjoyment and motivation following four different music conditions (dance, rock, inspirational, and no-music) during a running task. A number of participants found the task to be more enjoyable and motivational when listening to their preferred type of music from the options that were provided. Although the music was not purely self-selected, it suggests that using music preferences (such as allowing exercisers to pick their own music) as potential method of increasing intrinsic motivation during physical activity may be effective.

One potential explanation for this finding may be through perceived choice. Self-determination theory (Deci & Ryan, 1985) proposes that by having choice in a matter, an individual will have an increased sense of autonomy (a feeling of control or choice), making the behavioral experience more self-determined. According to this theory, greater autonomy is linked to more self-determined motives such as intrinsic motivation (enjoyment, challenge) rather than less self-determined motives (e.g., appearance; Deci & Ryan, 1985; Ryan & Deci, 2000). In this particular case, having a choice in music selection may have enhanced autonomy during the running task. A previous study investigated the concept of perceived choice of music on intrinsic motivation (Dwyer, 1995). It was found that participants reported increased motivation when they perceived themselves to have a choice in music selection during an aerobic exercise task, even though no choice was actually given. To our knowledge, this current study is the first to date to look at actual choice of music and how it may affect intrinsic motivation. Results indicate that having the ability to select one's own music may have been a potential reason for the higher intrinsic motivation when compared to the two other conditions.

5.2 Hypothesis 2: The Effect of Music on Physical Activity Enjoyment

It was hypothesized that enjoyment would be higher following the self-selected music condition in comparison to the researcher-selected and no-music conditions. The results showed that enjoyment was significantly greater following the self-selected music condition compared to the no-music control condition. However, there was no difference in enjoyment between the self-selected and the researcher-selected music conditions, or between the researcher-selected music condition and the no-music control condition.

This finding is consistent with other studies, which have found music to be beneficial in increasing enjoyment during physical activity. Miller and colleagues (2010) utilized a 20-minute treadmill test to assess music's effect on enjoyment. Twenty participants completed the task in a self-selected music condition and a verbal dialogue condition (via spoken word book), with conditions randomized. Results indicated that enjoyment was significantly greater in the music condition in comparison to the no-music condition. Moreover, Stork et al. (2015) also found that enjoyment was significantly higher in a music condition compared to a no-music condition during sprint interval training. With the findings of the current study showing enjoyment to be significantly greater in the self-selected condition in comparison to the no-music condition, but not significantly different than the researcher-selected, these studies suggest that music in general may be associated with higher enjoyment. This may be due to the ability of individuals to synchronize their movements to the music be it consciously or subconsciously (Karageorghis & Priest, 2012), making the running task rhythmic in nature and more pleasant when compared to the no-music condition. As enjoyment is seen as an important predictor for exercise involvement (Wankel, 1985), these findings indicate that music may be one way to enhance enjoyment of both continuous and interval physical activity.

5.3 Hypothesis 3: The Effects of Music on RPE

It was hypothesized that RPE would be higher following the self-selected music condition in comparison to the researcher-selected and the no-music conditions. The results showed that RPE was significantly greater in the self-selected condition than the other conditions, with no significant difference in RPE between the researcher-selected and the no-music conditions.

The conceptual model of the benefits of music in sport and exercise (Karageorghis & Priest, 2012) and early research examining the effects of music on RPE during exercise differ from the present study results. Karageorghis and Priest's (2012) review noted that music should decrease the rating of perceived exertion while performing physical activity, as music would act as a distractor from the physical work that is being done. Some experimental research has supported this claim with findings showing decreases in RPE during a treadmill running task when listening to music versus no-music (Szmedra & Bacharach, 1998) and a cycling task when listening to music compared to video, sensory deprived and a control conditions (Nethery, 2002).

However, more recent research has indicated that reduced RPE with music may not always be the case. Stork and colleagues (2015) noted that there was no significant difference in RPE between a music condition and a no-music condition when engaged in sprint interval training (SIT) workout. These authors found that despite a lack of difference in RPE, participants in the music condition did produce a greater power output, which indicated that they were objectively working harder than those in the no-music condition. The authors suggested that music might have less of an influence on RPE when exercise intensities exceed ventilatory threshold as in SIT, due to the heightened physiological cues (e.g., lactate build-up) experienced, which become more salient at increased exercise intensities. The effects of music on RPE may be more consistent when exercise intensities are not at maximal output.

In the current study, participants were able to select their exercise intensity by adjusting their speed throughout the trial. This self-selected nature allowed participants to work at their desired pace. RPE may have been higher in the self-selected condition due to the fact that participant's performance also increased – as shown by the significantly farther distance run during the self-selected music condition (see Hypothesis 4). Due to the fact that participants objectively ran further, it would stand to reason that accurate reporting of RPE would also be higher.

5.4 Hypothesis 4: Effects of Music on Distance Run

It was hypothesized that distance run would be greater following the self-selected music condition when compared to the researcher-selected and the no-music condition. The results revealed that participants ran significantly further in the self-selected music condition than in either the researcher-selected or the no-music conditions. However, there was no significant difference between the researcher-selected condition and the no-music control condition.

These results are supported by previous literature showing that music has a positive effect on performance variables, including power output during a Wingate test (Chtourou et al., 2012) and during sprint interval training (Stork et al., 2015), cadence during cycling (Lim et al., 2009) and relevant to this study, distance during a cycling task (Elliot et al., 2005). Elliot and colleagues (2005) found that there was a significant difference in distance between both music conditions (motivational and oudeterous – non-motivational) when compared to a no-music condition. However, they found no difference between the two music conditions, and the researchers concluded that there was no added benefit of motivational music over non-motivational music for increasing distance during a cycling task. The authors suggest that the similarity in distance may have been due to the participants' synchronization in both music conditions, and the ability to dissociate from the activity via the music since the task was done at submaximal intensities.

Differences between the two music conditions in the current study could be attributed to methodological differences between the current study and previous reserch. Specifically, the present study used a self-selected music condition rather than an oudeterous music condition and the task involved was a treadmill run rather than a cycling task. Findings indicate that perhaps the self-selected nature of music is important to improving ergogenic function during physical activity. It is possible that individualistic connections are formed to one's own musical preferences - the music is tied directly to the individual's experiences, preferences and the specific listening context (e.g. physical activity; Sloboda, 2008). This may cause greater effort due to the increases in intrinsic motivation, as music that heightens cultural and personal association are likely to enhance cognitive and affective results (Karageorghis & Priest, 2012). Thus, participants in the self-selected music condition may have been more motivated by their own song choices and more immersed in the activity, translating to improved performance as shown by increased distance when compared to the researcher-selected and the no-music control conditions.

5.5 Hypothesis 5: The Effects of Music on Heart Rate

It was hypothesized that heart rate would be lower following the self-selected music condition in comparison to the researcher-selected and no-music control condition.

However, contrary to the hypothesis, heart rate was not significantly different between any of the three conditions.

One possible explanation for this may have been that heart rate was not the best physiological response to measure. There are a number of factors that could have influenced participants' heart rates and perhaps made the measurement inaccurate. For example, the participants in the study were identified as regular exercisers, which may have accounted for a low resting heart rate within the sample to begin with (Kleiger et al., 2005), and therefore no significant difference would have been noted between conditions, due to the fact that there would be less fluctuation between resting and peak heart rate (Kleiger et al., 2005). Also, other variables may have affected heart rate, including emotions (e.g., anxiety over performance; Kleiger et al., 2005), whether or not participants had anything to eat or drink prior to performing the run (e.g., caffeine), or whether participants had adequate sleep before coming in to perform the trials.

Moreover, the assessment of heart rate may have been susceptible to measurement error. Although steps were taken to ensure that trials were done during the same time of day for each condition, not all trials were done at the exact same time due to participant availability. Research has been shown that there are variations in heart rate throughout the natural progression of the day (Kleiger et al., 2005). It is possible that the lack of difference in heart rate that was seen was due to the measuring of heart rate at different time points of the day.

5.6 Extending the Current Literature

This study has extended the current literature in several ways. First, to our knowledge, this is the first study that has examined the effects of self-selected music in comparison to researcher-selected motivational music on psychological, physiological and performance variables in a physical activity setting. Typically, the effects of music have compared a researcher-selected motivational music to a no-music condition (Chtourou et al., 2012; Eliakim et al., 2012; Seath & Throw, 1995), or a researcher-selected motivational to non-motivational and no-music conditions (Elliot et al., 2005). Despite there being evidence of music's effect within an exercise context, there has been virtually no research into wholly self-selected music in accompaniment of physical activity (Sloboda, Lamont, & Greasley, 2009). As music is commonly played at most exercise facilities and many athletes and exercisers use personal music devices during their workouts it is essential to determine how different aspects of music may positively or adversely affect exercisers within these contexts. In this study, self-selected music was shown to have significant positive effects on most of the variables that were measured compared to both researcher-selected and no-music conditions, which is a promising sign for further research into its use and implementation.

Secondly, this research indicates that self-selected music was associated with higher RPE, which was hypothesized, but is contradictory to the conceptual model of the benefits of music during sport and exercise (Karageorghis & Priest, 2012). This finding suggests that the relationship between RPE and music may be more complex than previously thought, and that perhaps some music may enhance effort in an exercise setting. This effect may occur due to the associative properties of self-selected music, wherein participants feel comfortable and connected to their own music. This personal association to music may bring about thoughts and feelings that may enhance the positive psychological aspects of music as proposed by previous research (Karageorghis & Priest,

2012) causing individuals to be more motivated. This increased motivation may in turn increase other aspects, including performance variables or other psychological constructs including affect or attitudes towards physical activity. Moreover, the results of the current study showed that there were no differences between the researcher-selected and the no-music control for intrinsic motivation, RPE and distance. This finding may indicate that there is limited benefit in playing researcher-selected music during a running task, perhaps due to the lack of associative or cultural connection, even when rhythm response and musicality are shown to be adequately motivational. Thus, it may be important to further investigate the importance of the external factors that make up the motivational qualities of music. To date, there has been limited investigation about its role on physical activity outcomes, with greater focus on the roles of rhythm response and musicality.

5.7 Limitations

While the current study has added to the literature and knowledge about music's effects on physical activity, there are several limitations that need to be acknowledged. Firstly, due to the fact that only young adults between the ages of 17-35 were recruited, the results of this study can only be generalized to that specific demographic. The generalizability of the results is also limited to regular exercisers, with many participants engaging in more than the recommended dose of physical activity (CSEP, 2012). Had this study been conducted with non-exercisers, it is possible that findings would have differed, due to the fact that participants may not have been able to maintain 30-minutes of prolonged physical activity. Furthermore, due to the self-report nature of the questionnaires used, social desirability and memory errors may also have occurred (e.g., physical activity in the last 7 days). Also, there may have been other factors that might have influenced study outcomes such as participants' engagement in prior physical activity between sessions, or the time of day at which they performed. Although instructions were given to limit the influence of these factors, there cannot be complete certainty that all participants followed the instructions.

In addition, other outcomes may have been influenced by the music, such as mood or body image, which may have distracted participants from the task. Moreover, since all trials were the same with the exception of the music that was/was not played, there may have been a possible learning or carry over effect from previous trials. Also, although instructions were given to run as far as participants could, the point can be made that participants did not give maximal effort as evident by the moderate RPE scores. Lastly, familiarity with the songs may have played a role. Although the researcher-selected playlist was comprised of "popular" songs from the last 5 years, it may have been possible that not all participants were as familiar with all the songs on that playlist (e.g., lyrics, melody, rhythm) as they would have been with their own self-selected playlists.

5.8 Future Directions

The current study has provided evidence of the positive effect of self-selected music on intrinsic motivation, RPE, and distance compared to researcher-selected and no-music, as well as partial support for its effect on enjoyment. Future research should attempt to replicate these findings in other samples (e.g., rehabilitation patients). Also, as this experiment was done in a controlled laboratory setting, it would be informative to note if these findings are supported within a real-world application (e.g., gym, fitness class). Although it was shown that self-selected music was most beneficial during a running task, the mechanism by which this occurs is still poorly understood. Future research should focus on teasing out the mechanisms by which self-selected music may influence physical activity by measuring the personal meaning of the music that was selected by participants (e.g., emotions the individual feels). This could possibly be done through a qualitative interview approach in order to identify major themes of personal musical choice. Also, it may be important to determine if the motivational qualities of music laid out by the BMRI-2 are set in a hierarchical order as stated by its authors, or if these may change based on the individual. For example, perhaps the memories that are brought about by the associative aspect of a particular song may be more motivational than the rhythm response, based on the particular individual or a particular setting. Lastly, future research should determine if the findings would differ based on the media source present during physical activity. This experiment used a speaker-based system to play music at a consistent volume over all conditions. The role of other delivery methods such as headphones or other types of media such as e-books, podcasts or television needs to be discerned, so that best practice exercise programs may be tailored to specific demographics.

5.9 Implications

As is well-known, physical activity comes with a number of health benefits (Warburton et al., 2006). However, inactivity levels are high in the Canadian population (CFLRI, 2009), causing many to miss out on the health benefits that are provided through physical activity. Since barriers such as lack of time, lack of motivation and lack of enjoyment play a role in whether or not one may engage in and adhere to physical activity (Chinn et al., 1999), finding ways to overcome these barriers is paramount to promote and sustain a healthy lifestyle. The use of self-selected music may be an inexpensive and practical method by which to address some of these barriers. As shown by this study, self-selected music resulted in higher intrinsic motivation than researcher-selected motivational music or the absence of music. Also, it was shown that self-selected music increased enjoyment in comparison to the no-music control during physical activity. Therefore, self-selected music demonstrated a positive effect on two of the three major barriers to being more physically active. As well self-selected music resulted in other positive outcomes such as increased RPE, suggesting greater work performed, which may increase the benefits of physical activity (e.g., weight loss, increased muscle mass). In turn, personal preference and choice in music selection may elicit positive outcomes through increased autonomy from both a psychological and performance standpoint, which may help increase physical activity initiation and participation.

The results of this study suggest that perhaps research has been asking the wrong questions about the effects of music on physical activity. Perhaps the equivocal findings about the benefits of music during exercise in research thus far have been due to a focus on the music selection or type of exercise and not enough on the individuals and their relation to the music. The conceptual model laid out by Karageorghis and Priest (2012) presents a framework by which researchers may investigate how music plays a role in physical activity. With this model, the internal factors (rhythm response and musicality) can be easily quantified and measured in a laboratory setting; however measurement of the external factors may prove to be more difficult based on the personal relationship of the music to the individual. This current study indicates that perhaps the relationship between music and physical activity may be more complex than stated in the model and that the order of factors may differ based on individual and personal preference in music. Therefore, better understanding of role of both internal and external factors of music may help to fully encapsulate music's effect on physical activity.

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APPENDICES

Appendix A: Classroom Announcement

Verbal Classroom Announcement

Hi, my name is Jermel Pierre and I am recruiting for a research study that examines personal characteristics and attitudes towards physical activity during a running task. Participation involves performing a 30-minute treadmill walking/running task on 3 separate occasions. Participation will take approximately 50-60 minutes per session and 2.5 – 3 hours total over the course of 3 sessions. You will be asked to provide a 30-minute list of songs that you prefer to run to. You will be asked to complete the running task in a private location located on the Brock University campus and complete a brief questionnaire package at each visit. Participants who complete this study will be offered $5.00 per attended session (maximum $15.00) in compensation or one hour per visit of research participation course credit. Individuals with no previous history or diagnosis of a hearing impairment, who can performed prolonged physical activity and can proficiently read and write English are eligible to participate. This study has received ethics clearance through Brock University Research Ethics Board (file #XX-XXX)

Appendix B: Poster

STUDY: Personal Characteristics and Attitudes towards Physical Activity & Running

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WHAT IS THE STUDY ABOUT?

Examining how personal characteristics, exercise motives and confidence affect running performance.

WHO CAN PARTICIPATE?

University aged participants who have no history or diagnosis of a hearing impairment, can performed prolonged physical activity and can read and write English proficiently

WHAT DO YOU HAVE TO DO?

Provide a personality description

Provide a 30-minute list of preferred music to run to
Complete a 30-minute walk/run (3 times)
Complete a brief questionnaire package at each visit
Participation will take approximately 50-60 minutes per session and 2.5 – 3 hours total over the course of 3 sessions

WHY GET INVOLVED?

Participants will be compensated either $5.00 per session attended (maximum $15.00 total) for their time or 1 hour per visit of research participation course credit (if applicable)

This study has received ethics clearance through Brock University Research Ethics Board (REB file: #xx-xxx)

Contact: Dr. Kimberley Gammage kgammage@brocku.ca
Jermel Pierre jp07ln@brocku.ca

Jermel Pierre Personality Characteristics & Attitudes towards Physical Activity & Running Performance jp07ln@brocku.ca	**Jermel Pierre** Personality Characteristics & Attitudes towards Physical Activity & Running Performance jp07ln@brocku.ca	**Jermel Pierre** Personality Characteristics & Attitudes towards Physical Activity & Running Performance jp07ln@brocku.ca	**Jermel Pierre** Personality Characteristics & Attitudes towards Physical Activity & Running Performance jp07ln@brocku.ca	**Jermel Pierre** Personality Characteristics & Attitudes towards Physical Activity & Running Performance jp07ln@brocku.ca

Appendix C: Physical Activity Readiness Questionnaire (PAR-Q)

Physical Activity Readiness
Questionnaire - PAR-Q
(revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
☐	☐	**1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	**2. Do you feel pain in your chest when you do physical activity?**
☐	☐	**3. In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	**4. Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	**5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	**6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	**7. Do you know of any other reason why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME ______________________________

SIGNATURE ______________________________ DATE ______________________________

SIGNATURE OF PARENT ______________________________ WITNESS ______________________________
or GUARDIAN (for participants under the age of majority)

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

Appendix D: Demographics

Demographic Information

Please complete the following information:

Age: _________ Year in school: _________

Height: _________ Weight: _________

Major: _____________________________ Gender: _____________

Types of Physical Activity Performed:

Cardiovascular: ____

Resistance Training: ____

Other: ____

Medical Conditions

List any current medical conditions or medications:

____

____

____

____

____

Appendix E: International Physical Activity Questionnaire – Short Form (IPAQ-S)

IPAQ

The questions are about your time you spent being physically active in the last **7 days**. They include questions about activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Please answer each question even if you do not consider yourself to be an active person.

In answering the following questions, 1. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. 2. **Moderate** physical activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

1a. During the last 7 days, on how many days did you do <u>**vigorous**</u> physical activities like heavy lifting, digging, aerobics, or fast bicycling?

Think about <u>ONLY</u> those physical activities that you did for at least 10 minutes at a time.

__________ days per week ⇨ 1b. How much time in total did you usually spend on one of those days during vigorous physical activities?

OR **______hours ________minutes**

☐ **None**

2a. Again, think <u>ONLY</u> about those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do <u>**moderate**</u> physical activities like carrying light loads, bicycling at a regular pace, or doubles in tennis? DO NOT include walking.

_________ days per week ⇨ 2b. How much time in total did you usually spend on one of those days during moderate physical activities?

OR **______hours ________minutes**

☐ **None**

3a. During the last 7 days, on how many days did you do **walk** for at least 10 minutes at a time? This includes walking at work and at home, walking to travel from place to place, and any other walking that you did solely for recreation, sport, exercise or leisure.

__________ days per week ⇨ 3b. How much time in total did you usually spend walking on one of those days?

OR **______hours ________minutes**

☐ **None**

Appendix F: Intrinsic Motivation Inventory (IMI)

IMI

Thinking about the run you just completed, for each of the following statements, please indicate how true it is for you, using the following scale:

1---------------2--------------3--------------4--------------5--------------6--------------7
Not at all true **Somewhat true** **Very true**

_____ 1. I enjoyed doing this walk/run very much

_____ 2. This walk/run was fun to do.

_____ 3. I thought this was a boring walk/run.

_____ 4. This walk/run did not hold my attention at all.

_____ 5. I would describe this walk/run as very interesting.

_____ 6. I thought this walk/run was quite enjoyable.

_____ 7. While I was doing this walk/run, I was thinking about how much I enjoyed it.

_____ 8. I put a lot of effort into this walk/run.

_____ 9. I didn't try very hard to do well at this walk/run.

_____ 10. I tried very hard on this walk/run.

_____ 11. It was important to me to do well at this walk/run.

_____ 12. I didn't put much energy into this walk/run.

Appendix G: Physical Activity Enjoyment Scale (PACES)

PACES

Please rate how you feel *at the moment* about the physical activity you have just completed

1							
	1	2	3	4	5	6	7
I enjoyed it							I hated it
2							
	1	2	3	4	5	6	7
I felt bored							I felt interested
3							
	1	2	3	4	5	6	7
I disliked it							I liked it
4							
	1	2	3	4	5	6	7
I found it pleasurable							I found it unpleasurable
5							
	1	2	3	4	5	6	7
I was absorbed in this activity							I was not at all absorbed in this activity
6							
	1	2	3	4	5	6	7
It was no fun at all							It was a lot of fun
7							
	1	2	3	4	5	6	7
It was very pleasant							It was very unpleasant
8							
	1	2	3	4	5	6	7
I felt as though I would rather been doing something else							I felt as though there was nothing else I would rather been doing

Appendix H: Rate of Perceived Exertion (RPE)

RPE

Please indicate on the following scale, how hard you believed yourself to be working during the run you just complete

RATING	DESCRIPTION
0	NOTHING AT ALL
0.5	VERY, VERY LIGHT
1	VERY LIGHT
2	FAIRLY LIGHT
3	MODERATE
4	SOMEWHAT HARD
5	HARD
6	
7	VERY HARD
8	
9	
10	VERY VERY HARD (MAXIMAL)

Appendix I: Certificate of Ethical Clearance

Brock University
Research Ethics Office
Tel: 905-688-5550 ext. 3035
Email: reb@brocku.ca

Bioscience Research Ethics Board

Certificate of Ethics Clearance for Human Participant Research

DATE:	7/7/2015		
PRINCIPAL INVESTIGATOR:	GAMMAGE, Kimberley - Kinesiology		
FILE:	14-258 - GAMMAGE		
TYPE:	Masters Thesis/Project	STUDENT: SUPERVISOR:	Jermel Pierre Kimberley Gammage

TITLE: The Influence of Environmental Factors on Physical Activity

ETHICS CLEARANCE GRANTED

Type of Clearance: NEW   Expiry Date: 7/29/2016

The Brock University Bioscience Research Ethics Board has reviewed the above named research proposal and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement. Clearance granted from **7/7/2015** to **7/29/2016**.

The Tri-Council Policy Statement requires that ongoing research be monitored by, at a minimum, an annual report. Should your project extend beyond the expiry date, you are required to submit a Renewal form before 7/29/2016. Continued clearance is contingent on timely submission of reports.

To comply with the Tri-Council Policy Statement, you must also submit a final report upon completion of your project. All report forms can be found on the Research Ethics web page at http://www.brocku.ca/research/policies-and-forms/research-forms

In addition, throughout your research, you must report promptly to the REB:

a) Changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) All adverse and/or unanticipated experiences or events that may have real or potential unfavourable implications for participants;
c) New information that may adversely affect the safety of the participants or the conduct of the study;
d) Any changes in your source of funding or new funding to a previously unfunded project.

We wish you success with your research.

Approved: [redacted]

Brian Roy, Chair
Bioscience Research Ethics Board

Note: Brock University is accountable for the research carried out in its own jurisdiction or under its auspices and may refuse certain research even though the REB has found it ethically acceptable.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of research at that site.

Appendix J: Letter of Invitation

Letter of Invitation

Project Title: Relationship between Personal Characteristics and Attitudes towards Physical Activity during a Running Task

Principal Investigator: Dr. Kimberley L. Gammage, Associate Professor, Department of Kinesiology, Brock University

Student-Investigator: Jermel Pierre, Master's Student, Faculty of Applied Health Sciences, Brock University

I, Kimberley Gammage, Associate Professor from the Department of Kinesiology, Brock University, invite you to participate in a research project entitled "The Influence of Environmental Factors on Physical Activity".

The purpose of this study is to better understand personal characteristics and attitudes towards physical activity while conducting a running task.

Only participants who indicate no previous history or diagnosis of a hearing impairment, are able to perform prolonged physical activity and are able to proficiently read and write English are eligible for this study.

Participation will take approximately 50-60 minutes per session and total of 2.5 – 3 hours over the course of 3 sessions. Prior to your 1st visit you will be asked to provide an approximately 30-minute compilation of preferred music to run to. You will be asked to complete a brief baseline questionnaire package at your first visit. You will take part in three 30-minute treadmill walk/runs in a private lab on campus. Each walk/run will be separated by at least 48 hours to ensure rest and full recovery. After each bout of physical activity, you will be asked to fill out a short questionnaire package about the session of physical activity which you just completed. A summary of your performance measures will be available to you after the completion of each session and we will offer either $5.00 per session attended (maximum $15.00 total) to you for participating in the study to compensate you for your time or course credit (1 hour/visit)

You may experience physical discomfort or injury (e.g. shin splints, strains or sprains) due to the active nature of this study; in this event, contact information for Dr. Gammage and student health services (905-688-5550 ext.3243, http://www.brocku.ca/healthservices) is provided. Information regarding physical activity recommendations can be found at the Canadian Society for Exercise Physiology CSEP (www.csep.ca)

Your participation will help better understand how personality and attitudes towards physical activity may effects various outcomes. This information will aid in structuring better protocols for scientific inquiry into physical activity as well as help develop better interventions to aid in physical activity adherence.

If you have any pertinent questions about your rights as a research participant, please contact the Brock University Research Ethics Officer (905-688-5550 ext. 3035, reb@brocku.ca)

If you have any questions, please feel free to contact me.

Thank you

Principal Investigator:
Kimberley Gammage, Associate Professor
Department of Kinesiology
Brock University
905-688-5550 (x3772)
kgammage@brocku.ca

Student-Investigator:
Jermel Pierre, Master's Student
Faculty of Applied Health Sciences
Brock University
905-688-5550
jp07ln@brocku.ca

This study has been reviewed and received ethics clearance through Brock University Research Ethics Board (file #XX-XXX)

Appendix K: Informed Consent

Informed Consent

(on letterhead)

Date: April 2015

Project Title: The Relationship Between Personal Characteristics and Attitudes towards Physical Activity during a Running Task

Principal Investigator:
Kimberley Gammage, Associate Professor
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Student-Investigator:
Jermel Pierre, Master's Student
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Brock University
905-688-5550
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INVITATION
You are invited to participate in a research study that will explore the influence of personal characteristics and attitudes towards physical activity during a running task. Only participants who indicate no previous history or diagnosis of hearing impairment, who are able to performed prolonged physical activity and are proficient in reading and writing of English will be able to partake in this study.

WHAT'S INVOLVED
As a participant, you will be asked to complete a brief questionnaire and take part in a 30-minute treadmill walk/run separated by at least 48 hours in a private setting on campus. Participation will take approximately 50-60 minutes per session and 2.5-3 hours total of your time total over the course of all three sessions. A summary of your performance results will be available for you after each session is completed.

POTENTIAL BENEFITS AND RISKS
We will offer $5.00 per session attended (maximum $15.00 total) to you for participating in the study to compensate you for your time or one hour per visit of research participation course credit. Your participation will help better understand the effects of music on physical activity. There is a possibility you may experience some discomfort due to the physically active nature of the study (e.g. physical stress, fatigue); in this event, contact information for Dr. Gammage and student health services (905-688-5550 ext.3243, http://www.brocku.ca/healthservices) is provided. Information regarding physical activity recommendations can be found at the following official website: www.csep.ca.

CONFIDENTIALITY/ANONYMITY
Anonymity cannot be offered in this study given the nature of the study. A master list of participants' names and ID numbers will be collected in order to match up data from each visit. This list will be kept in a locked file cabinet in a locked office within a laboratory that will be locked as well and will be kept separate from the data. Once data collection is completed the master list will be destroyed and there will be no personal identification retained. Any information that arises from participants will be treated with confidentiality. Your name will not be included or, in any other way, associated with the data released from the study. Please do not place your name or any identifying information on the questionnaire. Data collected during this study will be stored in a locked filing cabinet of the research laboratory of Dr. Gammage at Brock University. They will be retained until five years past publication of the research. At this time, written documents will be shredded. Access to this data will be restricted to the research team.

VOLUNTARY PARTICIPATION
Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study. Further, you may decide to withdraw from this study at any time and may do so without any penalty or loss of benefits to which you are entitled ($5.00 per session attended) or one hour per visit of research participation course credit If a participant wishes to withdraw prior to the third and final visit of the study, their data will be destroyed. If a participant wishes to withdraw after data collection has been completed then data will no longer be unidentifiable and they will not be able to withdraw. If a participant wishes to withdraw, the primary researcher or primary student researcher will debrief them on the purpose of the study and answer any questions that the participant may have in order to field any concerns of the participant

PUBLICATION OF RESULTS
Results of this study may be published in professional journals and presented at conferences. Feedback about this study will be available. At your request you may receive a summary of results by completing the request for summary of results form.

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please contact the Research Team using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University (file #XX-XXX). If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at 905-688-5550 ext. 3035, reb@brocku.ca.

Thank you for your assistance in this project. Please keep a copy of this form for your records.

CONSENT FORM
I agree to participate in this study described above. I have made this decision based on the information I have read in the Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

Name: ____ (please print)

Signature: ______________________________ Date: ______________________

Appendix L: Debrief Script

Debriefing Script

Now that you are all done, I want to tell you a little more about the study. The true purpose of this study was to look at the effect of music during physical activity, specifically self-selected music (music selected by you), researcher-selected music (motivational music selected by the researcher – me – using the BMRI-2), which is a tool that helps researchers select motivational music for research purposes. Music has been shown to have mixed effects on physical activity, with some research indicating that there are positive effects, and other studies showing that there is no effect of music during physical activity. With these equivocal findings we were interested to see if self-selected music would show significant differences in psychological, physiological and performance variables when compared to the other two conditions (researcher-selected and no-music control). Participants provided a 30-minute long list of their preferred music to run to, while the researcher compiled a list of motivational music from the last 5 years using the BMRI-2. During the control condition no music was played and participants were told that there was a problem with the stereo. Participants were randomly assigned to the order that they would be completing the three trials prior to their initial visit.

Appendix M: Performance Results

Performance Results

Visit 1 **Condition:________________**

Time	**Distance**	**RPE**	**Heart Rate**

Visit 2 **Condition:________________**

Time	**Distance**	**RPE**	**Heart Rate**

Visit 3 **Condition:________________**

Time	**Distance**	**RPE**	**Heart Rate**

Appendix N: Final Consent Form

Informed Consent Form

Project Title: The Relationship Between Personal Characteristics and Attitudes towards Physical Activity during a Running Task

Principal Investigator: Dr. Kimberley Gammage, Associate Professor, Department of Kinesiology, Brock University

Principal Student Investigator: Jermel Pierre, Master's Student, Faculty of Applied Health Sciences, Brock University

The true purpose of this study was to look at the effect of music during physical activity, specifically self-selected music (music selected by you), researcher-selected music (motivational music selected by the researcher – me – using the BMRI-2), which is a tool that helps researchers select motivational music for research purposes. Music has been shown to have mixed effects on physical activity, with some research indicating that there are positive effects, and other studies showing that there is no effect of music during physical activity. With these equivocal findings we were interested to see if self-selected music would show significant differences in psychological, physiological and performance variables when compared to the other two conditions (researcher-selected and no-music control). Participants provided a 30-minute long list of their preferred music to run to, while the researcher compiled a list of motivational music from the last 5 years using the BMRI-2. During the control condition no music was played and participants were told that there was a problem with the stereo. Participants were randomly assigned to the order that they would be completing the three trials prior to their initial visit

Re-Consent:

I was informed that deception was used in this study, and that having full knowledge of the true purpose of the study may have influenced the way in which I completed the questionnaires and performed on the running tasks. However, I am now informed of the true purpose of this study. In addition, I have had the opportunity to ask questions have received acceptable answers to my questions. I have been asked to give permission to the researchers to use my data in their study, and agree to this request. During the debriefing session, I was given an explanation as to why the researchers had to disguise the true purpose of this study. Contact information for Dr. Gammage, student health services (905-688-5550 ext.3243, http://www.brocku.ca/healthservices) is provided. Information regarding physical activity recommendations can be found at the following official websites: www.csep.ca. I am aware I may contact Brock University's Research Ethics Office regarding my rights as a research participant (905-688-5550 ext. 3035 or reb@brocku.ca).

Date: ____________________________

Participant name (please print): ______________________________________

Participant signature: ____

Principal Investigator:
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